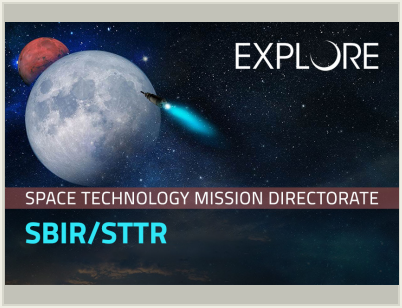
Virtual Redundancy for Safety Assurance in the Presence of Sensor Failures, Phase II

Completed Technology Project (2015 - 2017)

Project Introduction

Both vehicle automation systems and human pilots rely heavily on sensor feedback to safely control aircraft. The loss of reliable information for even a single state feedback signal can initiate a chain of events that leads to an accident. On small aircraft, hardware redundancy is often impractical and the failure of a single physical sensor could be the triggering event that leads to an accident. On commercial transport aircraft sensor hardware redundancy is common, but the potential for common-mode failures means sensor failures are still an important consideration. In many cases, there is adequate information available to accurately estimate the true value of a parameter even if the sensor or sensors that directly measure the parameter have failed. In the best case, a human pilot can exploit the available information to successfully fly the vehicle after a sensor failure, but it is a high workload task. In many cases, lack of situational awareness and poor manual piloting skills create a situation in which the human pilot cannot safely handle the failure. Similarly, many automation systems are unable to safely cope with failures. The proposed research will build on the successful phase one proof-of-concept demonstration to develop a virtual sensor redundancy system that identifies and isolates faulted sensors, and fuses information from healthy sensors and vehicle dynamics models (including arbitrary nonlinear models) to estimate correct outputs for faulted sensors. The research will also develop the Virtual Sensor Toolkit, a software tool that supports the entire lifecycle of virtual sensor development and deployment from requirements development to testing and design updates. Barron Associates has partnered with commercial unmanned air system producers to advance the TRL of the technology through an aggressive Phase II development and testing effort that prepares the team for flight tests immediately following Phase II.



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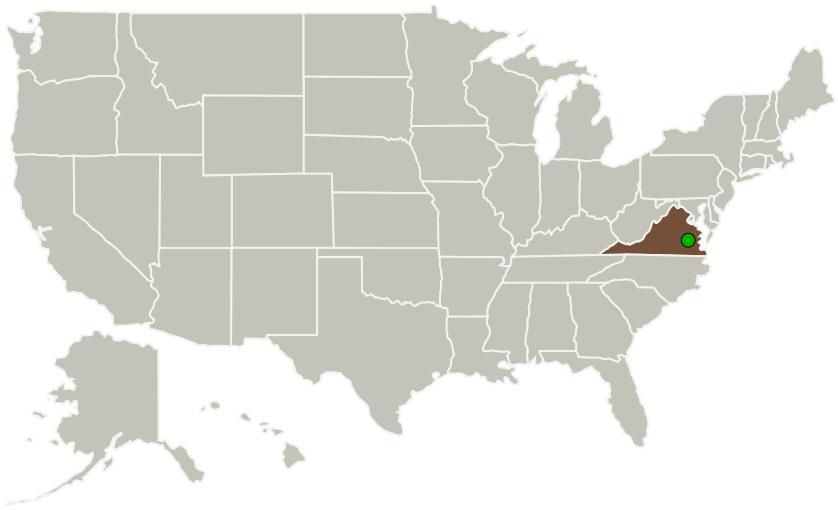
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Barron Associates, Inc.	Lead Organization	Industry	Charlottesville, Virginia
Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations
Virginia

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Barron Associates, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Richard Adams

Co-Investigator:

Alec Bateman

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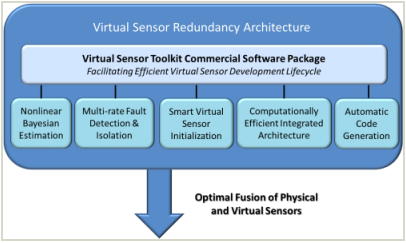
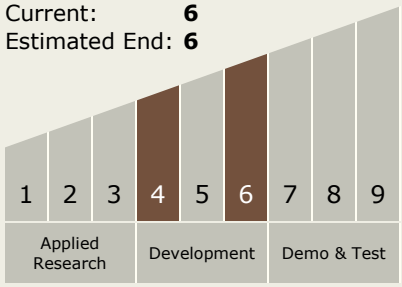
Images



Briefing Chart
Virtual Redundancy for Safety Assurance in the Presence of Sensor Failures Briefing Chart *(https://techport.nasa.gov/image/128490)*

Technology Maturity (TRL)

Start: **4**
Current: **6**
Estimated End: **6**



Technology Areas

Primary:

- TX10 Autonomous Systems
  - TX10.2 Reasoning and Acting
    - TX10.2.6 Fault Response

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System